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[MED 8: Mining Techniques and Equipment]

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भारतीय मानक

खान ढुलाई ट्रैक — रीति संहिता

(पहला पुनरीक्षण)

Indian Standard

MINE HAULAGE TRACKS — CODE OF PRACTICE

(First Revision)

ICS 73.100.04

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

June 2012 **Price Group 10**

Mining Techniques and Equipment Sectional Committee, MED 08

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Mining Techniques and Equipment Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1992. The Committee decided to amalgamate IS 13163 : 1991 'Mine haulage tracks — Laying — Code of Practice', IS 13201 : 1991 'Mine haulage tracks — Rails and fish plates — General requirements', and IS 13210 : 1991 'Mine haulage tracks — Switches and crossings — General requirements on mine haulage tracks' in IS 13202 to have a single and comprehensive standard on mine haulage tracks. Hence IS 13163 : 1991, IS 13201 : 1991 and IS 13210 : 1991 shall stand withdrawn. In this revision, requirements of rail designation ISLR 10 and ISLR 12 have been deleted since these are not being used in the mining now-a-days. The recommended dimensions of turnouts off straight track for ISLR 15 have been included.

This standard is expected to rationalize the practices followed, provide uniform guidelines to those laying and using the tracks, proper installation of haulage tracks for better life and less down time, general requirements of switches and crossings, rails and fish plates for use in underground mines. The standard also provides brief information on periodical inspection and maintenance of such tracks.

In the formulation of this standard, due consideration has been given to the existing manufacturing processes, general uses and practices etc, being followed.

Notwithstanding the requirements of statutory bodies or specified otherwise for mine haulage tracks, the requirements given in this standard are expected to provide uniform guidelines for design and equipments used for mine haulage tracks.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

MINE HAULAGE TRACKS — CODE OF PRACTICE

(First Revision)

1 SCOPE

This Code covers the requirements of mine haulage tracks and its components such as rails and fish plates, switches and crossings and laying of tracks.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
3964 : 1980	Light rails (*first revision*)
9203	Friction rollers for mine haulage tracks:
(Part 1) : 1979	Technical supply condition
(Part 2) : 1979	Parallel rollers
(Part 3) : 1979	Tapered and vertical rollers and horizontal and vertical pulleys
(Part 4) : 1979	Rollers with non-metallic rope bearing surfaces
9227 : 1979	Specification for friction roller mountings for mine haulage tracks

3 GENERAL REQUIREMENTS

3.1 While laying haulage tracks, relation between rail gauge, track weight and haul load shall be kept in view.

3.2 Rails

3.2.1 Rails used for mine haulage tracks along with designation, material specification, dimensions and tolerances shall conform to IS 3964.

3.2.2 *End Preparation*

3.2.3 *Squareness*

The ends of rails shall be sawn true and square. Squareness of the cut end shall be maintained within ± 0.1 mm.

3.2.4 *Verticality*

The verticality of rails shall be maintained within ±0.3 mm.

3.2.5 *Straightness*

Straightness of the rails shall be maintained as follows:

a) Rails up to 6 m long shall be within ± 1 mm/m but shall not exceed ± 4 mm in total; and
b) Rails above 6 m long but within 10 m shall be maintained within ± 6 mm.

3.2.6 *Camber*

Positive camber of the rails shall be maintained within 2 mm. Negative camber shall not be allowed.

3.2.7 *Profile*

The deviation of the profile dimension shall not exceed ± 0.5 mm anywhere.

3.2.8 *Sweep*

Sweep shall be maintained within 2 mm for each 6 m length but shall not exceed 6 mm in total.

3.2.9 *Twist*

Twist shall be maintained within ± 10.2 mm.

3.3 Holes

3.3.1 *Holes in Rail*

Holes for fish bolts in the rails shall be made for fastening fish plates through the web at each end.

3.3.2 *Method of Making Holes*

3.3.2.1 Holes shall be either drilled or be punched perpendicular to the web of the rail at one stroke of the machine. The holes shall be clean and free from burrs and cracks.

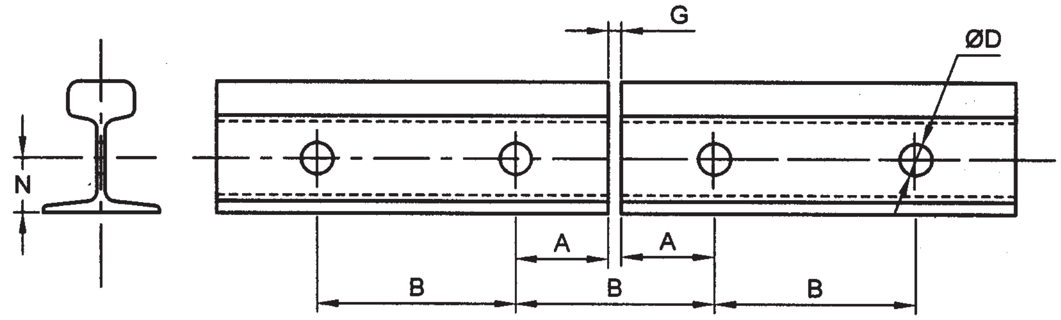
3.3.2.2 Dimensions of the rail holes shall be as specified in Fig. 1.

3.3.3 *Nail Holes*

3.3.3.1 When rails are required to be provided with nail holes, this shall be stated in the purchase order.

3.3.3.2 The nail holes shall be either drilled or punched parallel with the vertical axis of the rail. The holes shall be clean and be free from burrs and cracks.

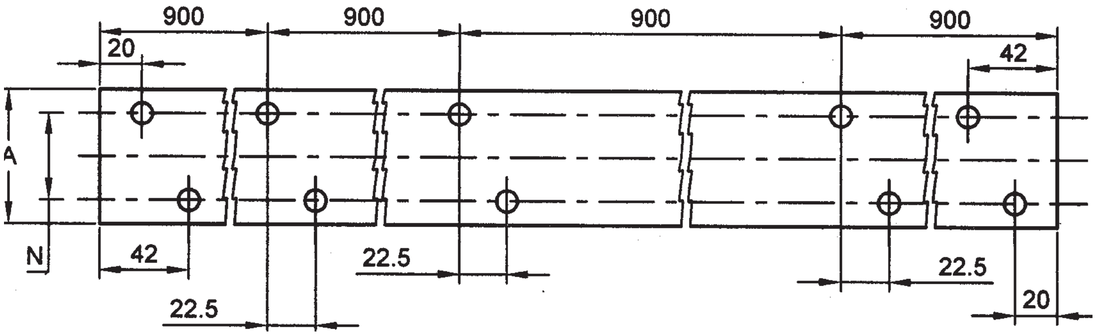
3.3.3.3 Dimensions of the nail holes shall be as specified in Fig. 2, where the rail length is a multiple of 900 mm. For other rail lengths the pitching of the holes shall be as specified by the purchaser.



Designation of Rails	Nominal Mass of Rail, kg/m	G ±1.6	A ±1.6	B ±1.6	ØD	N
ISLR 15	14.5	6	42	90	18.5	33

All dimensions in millimetres.

FIG. 1 DIMENSIONS OF RAIL HOLES



Designation of Rails	Nominal Mass of Rail, kg/m	Width of Flange A	Hole Centres N	Hole Diameter
ISLR 15	14.5	76.20	54.00	12.5

All dimensions in millimetres.

FIG. 2 DIMENSIONS OF NAIL HOLES

3.3.3.4 Variations in rail length, within the length tolerance specified, shall be accommodated at the end pitches.

3.4 At curves, in a mine haulage track system, a brick wall shall be made and shall be provided with grooves to fix vertical pulleys/rollers conforming to IS 9203 (Part 3). A skid plate arrangement with wooden lining fixed on steel plate at suitable height with countersunk bolts may also be provided for smooth guidance of the passing tubs.

3.5 Safety Devices

While designing haulage track system for mine, safety devices such as intercoupled run-away switch, stop block, drop warrick, re-railer, etc, shall be suitably incorporated in the track system in accordance with Statutory Acts, Rules and Regulations.

3.6 Rail Joints

The track shall be laid in such a way that all the rail joints shall be square across the track and not staggered. However, on curves this requirement does not apply. Such a laying of track reduces rolling of locomotives and simplifies track laying and track maintenance.

3.7 Sleepers at Joints

3.7.1 Sleepers shall be placed on each side of the joint.

3.7.2 Location of the sleepers shall be kept as close as the fish plate shall allow.

3.7.3 No sleepers shall be placed directly under rail joints. This shall cause heavy sleeper wear with a tendency for high spots to form at the rail end.

3.8 Gauge Ties

3.8.1 Gauge ties shall be used to maintain the gauge of the track. This shall be used particularly near rail joints on curved track where side sway of wheel flanges tend to spread the gauge. Gauge ties are also important where the available sleeper timber has poor holding quality.

3.8.2 Gauge ties shall be used at intervals of 5 m in the track.

3.8.3 An illustration of flat gauge tie and clips is given in Fig. 3

4 FISH PLATES

4.1 Fish plates shall be used to fasten two rails during track laying. These specially designed fish plates also prevent the bolts from turning when the nuts are tightened.

4.2 Material

The fish plates shall be made of carbon steel with a tensile strength of 400 to 500 N/mm^2 and a minimum elongation of 20 percent.

4.3 Dimensions

Fish plates are normally in sections A, B and C (not formal designations) and the dimension and tolerances of these fish plates shall be in accordance with Fig. 4 to Fig. 6 respectively.

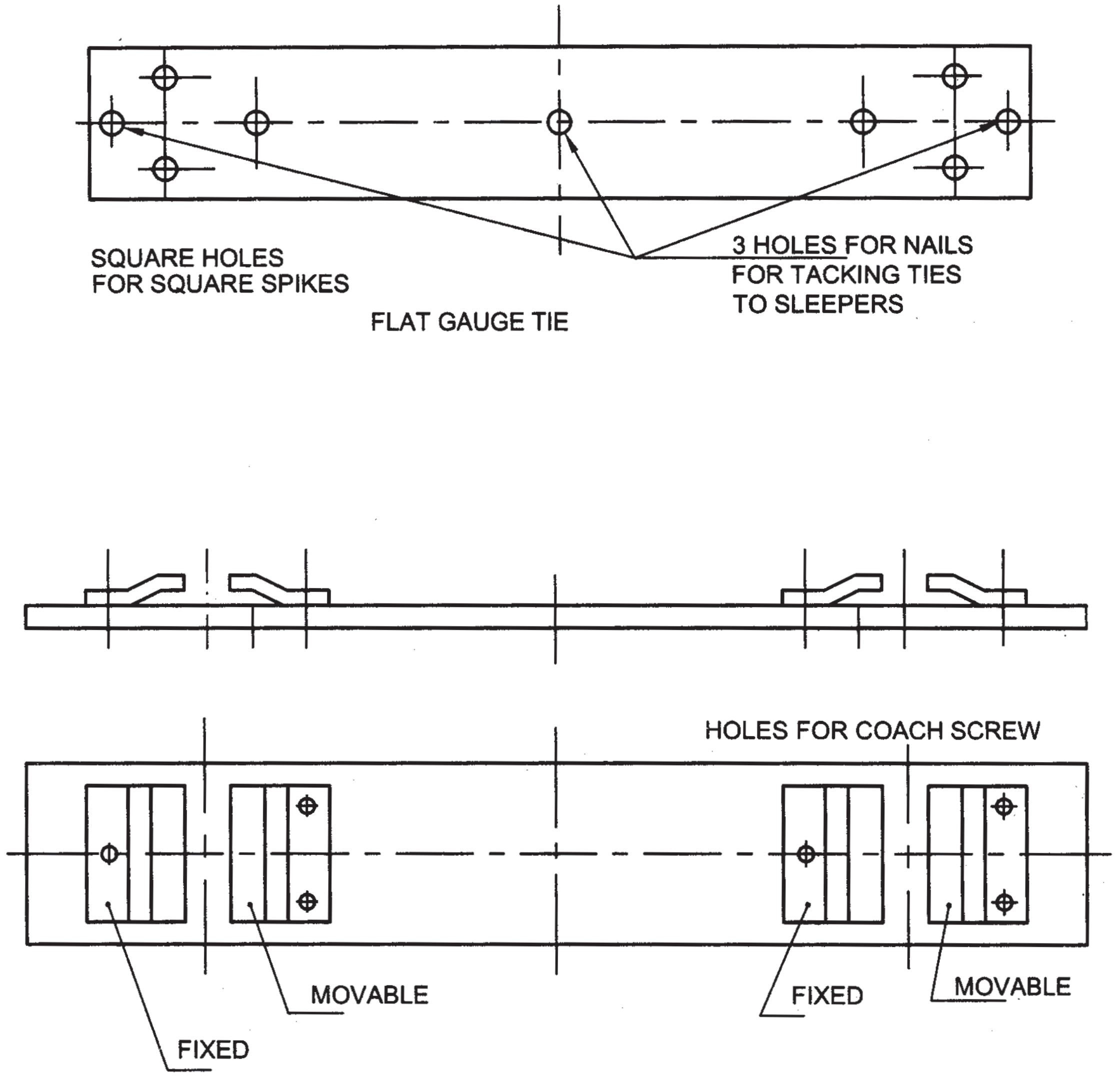
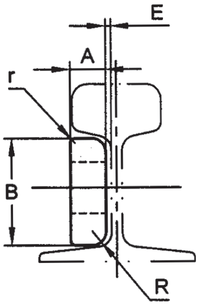
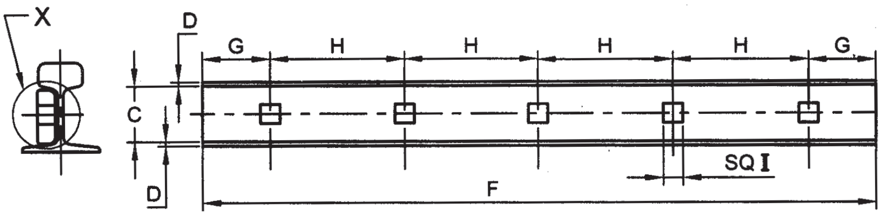


Fig. 3 Flat Gauge Tie and Clips



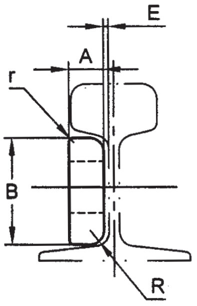
ENLARGED DETAIL AT X



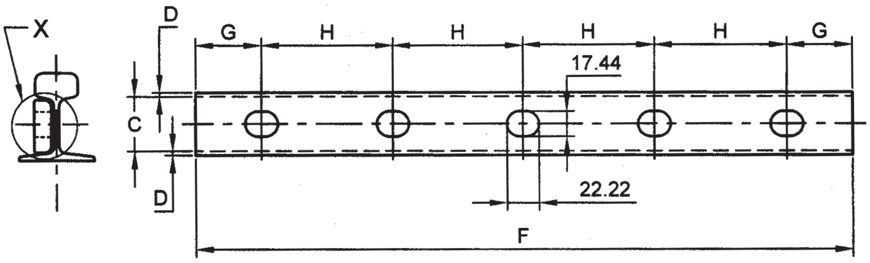
Designation of Rails	*Nominal Mass of Rail*, kg/m	*A* ±0.4	$B^{+1.10}_{-0}$	$C^{+1.10}_{-0}$	*D*	*E*	F^{+6}_{-0}	G^{+2}_{-0}	*H* ±11	I^{+2}_{-0}	*R*	*r*
ISLR 15	14.5	12.8	48.8	42.2	3.2	2.4	360	45	90	17	6.35	1.59

All dimensions in millimetres.

FIG. 4 'A' SECTION FISH PLATE



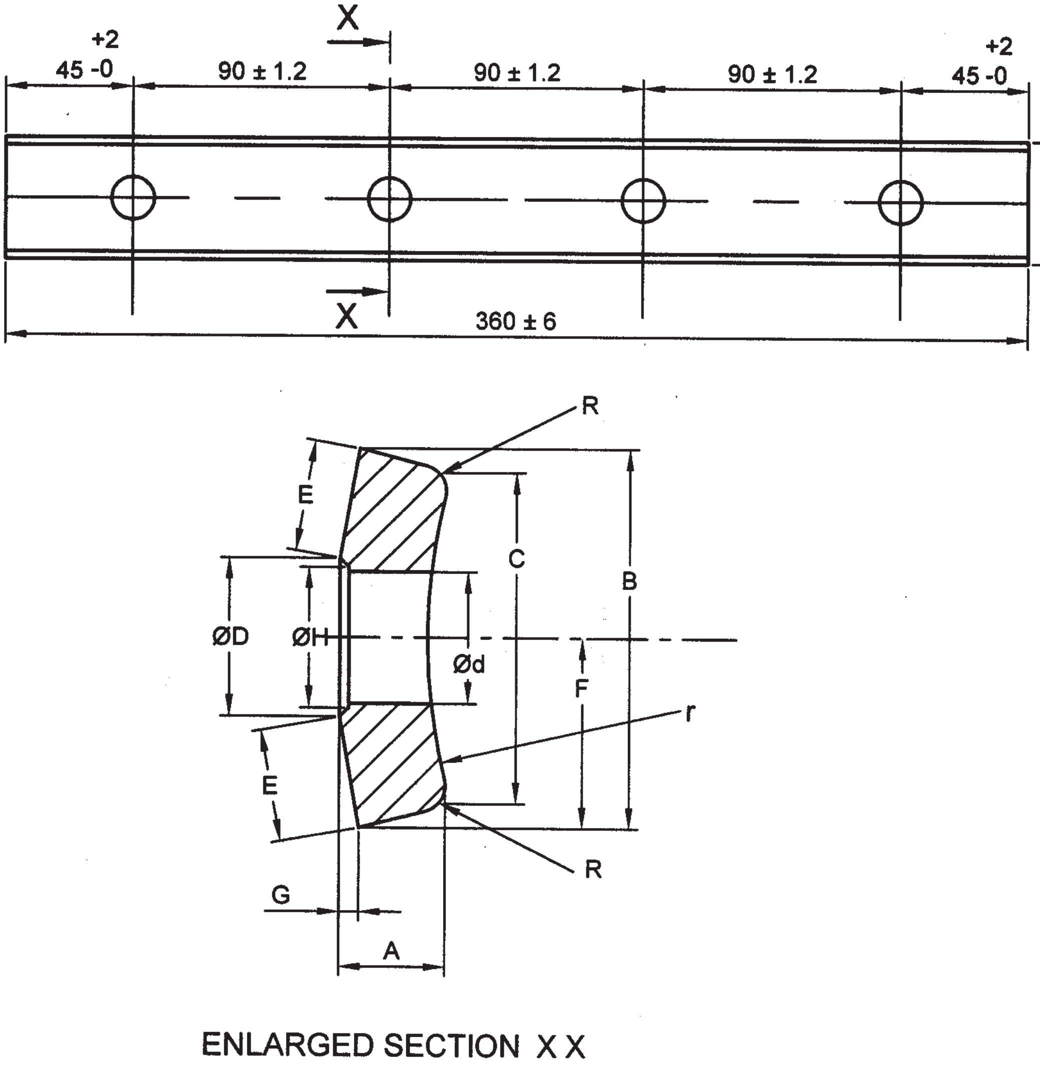
ENLARGED DETAIL AT X



Designation of Rails	*Nominal Mass of Rail*, kg/m	*A* ±0.4	$B^{+1.10}_{-0}$	$C^{+1.10}_{-0}$	*D*	*E*	F^{+6}_{-0}	G^{+2}_{-0}	*H* ±1.2	*R*	*r*
ISLR 15	14.5	12.8	48.8	42.2	3.2	2.4	360	45	90	6.35	1.59

All dimensions in millimetres.

FIG. 5 'B' SECTION FISH PLATE



Designation of Rails	*Nominal Mass of Rail*, kg/m	*A* ±0.4	$B^{+1.10}_{-0}$	$C^{+1.10}_{-0}$	*D*	*d*	*E*	*F*	*G*	*R*	*r*
ISLR 15	14.5	14	48.8	42	22	19	14	24.4	2	5	75

All dimensions in millimetres.

FIG. 6 'C' SECTION FISH PLATE

4.4 Fixing of Fish Plates

Fish plates shall engage the fishing surfaces of both the head and flange of the rail with a working gap between inner face of the fish plate and web of rail when bolted up.

4.5 Cutting

The ends of the fish plates shall be sawn or sheared and shall be square. Cut ends shall be clean and free from burrs.

4.6 Straightness

The fish plates shall be straight and of uniform section.

4.7 Holes

The holes in fish plates shall be made by drilling or punching at one stroke of the machine. Holes shall be clean and without burrs and cracks.

5 VERTICAL TRANSITION CURVES AT CHANGES IN GRADIENT

5.1 Abrupt changes in gradient of haulage track shall be avoided.

5.2 Vertical transition curves in tracks shall be used at all points, where the gradient changes.

5.2.1 Provision of vertical transition curves shall prevent trouble with coupling and in case of vehicles with a small clearance above rail level, prevent fouling at abrupt changes of gradient.

5.3 For locomotive haulages, the clearance between locomotive buffer beam and the rail is a limiting factor and in this case a radius of 60 m shall be suitable.

5.4 For direct rope haulage installations using mine cars a radius smaller than 60 m may be acceptable, depending on the design of the vehicle. In some cases, a radius of 30 m has been found to be satisfactory.

5.5 Table 1 gives the details of suitable vertical transition curve obtained as follows:

Let

D = distance between lowest points of vehicle, in m;

C = clearance above rail level at these lowest points when standing on level track, in m;

C_1 = clearance, above rail level at these points when standing on vertical curve, in m;

n = wheel base of vehicle, in m; and

R = radius of vertical curve, in m.

Then,

$$R=\frac{D^2-n^2}{8(C-C_1)} \qquad ...(1)$$

Length of vertical curves for given radius and gradient (*see* Table 1),

$$M = \frac{R\pi}{180} \times \text{ angular change of gradient, in degree}$$

or, $$M = \frac{RK\pi}{180} \qquad ...(2)$$

N = height of vertical curve for given radius and gradient (*see* Table 1),

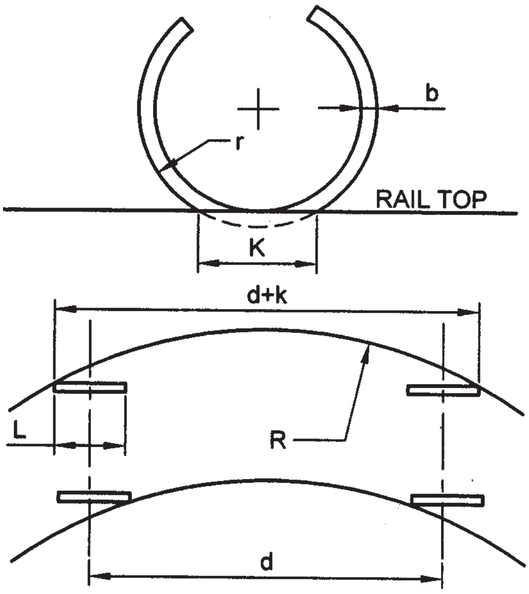
$$N = 2\,R\,\sin^2(K/2) = M^2/(2\,R) \qquad ...(3)$$

6 CURVED TRACK

6.1 Radii of Curves

6.1.1 Curved tracks shall always be set out with as large a radius as possible. The larger radius gives easier running of rolling stock and so reduces wear on wheels, axle boxes, locomotive side rods and tracks with a consequent reduction in running cost which shall help to compensate for any extra cost involved in preparing the roadways for and laying of large radius tracks.

6.1.2 The suitable minimum radius of curve over which individual vehicle shall travel, whether locomotive, mine car or tub, may be obtained as follows for four-wheeled vehicle.



Let

r = radius of wheel to point to flange;

b = depth of flange;

K = length of portion of flange below rail top;

M = difference between wheel gauge and track gauge;

R = radius of curve to outside rail; and

D = wheel base of vehicle.

Then,

$$K = \sqrt{(8\,b\,r)}$$

If the vehicle is to traverse the curve without increase of gauge, the value of M shall be the same as on straight track.

Then,

$$R = D\,K\,/\,(2\,M)$$

NOTES

1 All the parameters shall be taken in same units.

2 It is sometimes preferred to work to half the depth of the wheel flange as this method gives a smaller value to the minimum radius.

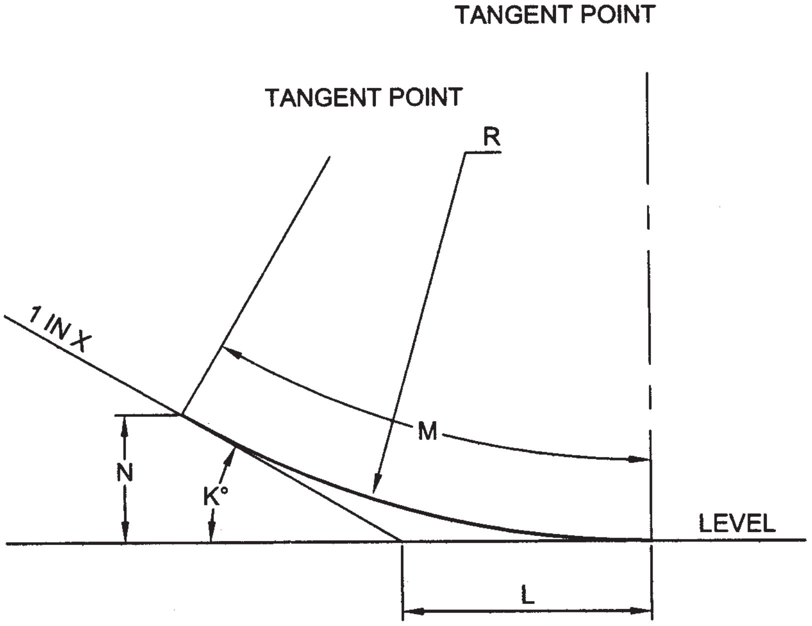
6.1.2.1 The value(s) obtained in accordance with **6.1.2** shall give the absolute minimum values of radius and that the radius actually used shall be kept as much in excess of this value as circumstances shall allow.

6.1.2.2 Minimum radius for a train of vehicles, whether hauled by a locomotive or a rope, shall also depend on the following factors:

a) Rigid wheel base of vehicles,
b) Wheel diameter,
c) Wheel gauge,
d) Rail gauge,

Table 1 Heights and Lengths of Vertical Curves for 30.5 m and 61 m Radius and Various Gradients

(*Clause* 5.5)



Sl No.	**Gradient**			***R* = 30.5 m**			***R* = 61 m**	
	(1 in X)	*K*		Length of Curved Rail (to Nearest Metre) *M*	Height *N*	Tangent Point *L*	Length of Curved Rail (to Nearest Metre) *M*	Height *N*
		Deg	Min	m	mm	m	m	mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	1 in 2	26	34	14.148	3 277	7.194	28.271	6 753
ii)	1 in 3	18	26	8.830	1 581	4.947	19.634	3 160
iii)	1 in 4	14	2	7.467	914	3.763	14.935	1 829
iv)	1 in 4.5	12	32	6.680	724	3.347	13.411	1 524
v)	1 in 5	11	19	6.020	597	3.017	12.065	1 194
vi)	1 in 6	9	27	5.029	416	2.520	10.058	832
vii)	1 in 7	8	8	4.343	308	2.165	8.661	616
viii)	1 in 8	7	7	3.785	235	1.899	7.570	470
ix)	1 in 9	6	20	3.379	187	1.689	6.706	368
x)	1 in 10	5	43	3.048	152	1.521	6.096	305
xi)	1 in 11	5	12	2.769	127	1.384	5.537	251
xii)	1 in 12	4	46	2.540	105	1.270	5.080	210
xiii)	1 in 13	4	24	2.337	89	1.168	4.674	178
xiv)	1 in 14	4	5	2.184	76	1.086	4.343	156
xv)	1 in 15	3	39	2.032	67	1.016	4.064	137
xvi)	1 in 16	3	34	1.905	60	1.952	3.810	117
xvii)	1 in 17	3	22	1.803	51	1.895	3.607	105
xviii)	1 in 18	3	11	1.702	48	1.845	3.382	92
xix)	1 in 19	3	1	1.600	41	1.800	3.226	86
xx)	1 in 20	2	52	1.524	38	0.762	3.048	76
xxi)	1 in 21	2	44	1.448	35	0.724	2.896	70
xxii)	1 in 22	2	36	1.397	32	0.692	2.772	64
xxiii)	1 in 23	2	29	1.321	29	0.660	2.642	57
xxiv)	1 in 24	2	23	1.270	25	0.635	2.540	51
xxv)	1 in 25	2	17	1.219	23	0.610	2.458	48
xxxi)	1 in 26	2	12	1.168	22	0.584	2.337	44
xxvii)	1 in 27	2	7	1.143	22	0.565	2.286	41
xxviii)	1 in 28	2	3	1.092	19	0.546	2.184	38
xxix)	1 in 29	1	58	1.041	19	0.527	2.108	35
xxx)	1 in 30	1	54	1.016	16	0.508	2.032	32

e) Overhang of vehicle beyond wheel base,
f) Design of couplings and buffer gear,
g) Speed, and
h) Super elevation.

6.1.2.3 It shall be important to note that when mine cars are travelling on curves with buffers compressed, there shall be a possibility that fouling may occur on the other equipment fitted to the ends of vehicles.

6.1.2.4 The radius shall be so related to the rolling stock that the amount of end throw is less than that which shall result in buffer locking, or in the case of central buffer arrangement shall exceed the limits of flexibility of the coupling.

6.1.2.5 With reverse curves, the effect of end throw shall be aggravated by opposing throws of the curves and it shall be necessary to interpose a length of straight rail between tangent point of the curves.

6.1.3 Assuming the provision of super elevation appropriate to the speed, the locomotive haulage scheme may have satisfactory operation of trains on curves with following radii:

Speed km/h	*Radius* m
Up to 8	30
8-16	30-60
16-24	60-90

6.1.4 Where it is desired that radius shall be less than 30 m, the jobs shall always be laid out on drawing board before making a final choice.

6.1.5 Where the indications are that the proposed radius shall be near the limit of maneuverability, an actual test shall be made on the surface with rails set to the proposed radius.

6.2 Bending of Rails

6.2.1 For case in setting the track to gauge, the outer and inner rails of the track shall be bent to their correct respective radii and not to the centre line radius of the track.

6.2.2 Illustration of the offset for bending each rail to its correct radius especially for radii less than 45 m is given in Table 2. For centre line radii greater than this, the difference in radii of two rails of a single track may be negligible.

6.2.3 In the case of double track roadway the difference between the rail radii shall even be greater. Thus it is recommended that each case be treated individually. Illustration for bending of rails is given in Fig. 7 and Fig. 8.

a) Details of bend rails for vertical curves for 30.5 m radius and gradients 1 in 3, 1 in 4.5 and 1 in 6 shall be as given in Fig. 7.
b) Offsets for bending rails to various centre line radii (*see* Table 2) shall be calculated as given in Fig. 8.

6.3 Super Elevation

6.3.1 On a curve, centrifugal force creates a tendency for the train to leave the track and proceed along a straight course tangential to the curve. This throws the wheel flanges hard against the inner edge of the outer rail, causing excessive wear of wheels and rails. So to counteract this and equalize the pressure on the two rails, the outer rail shall be raised above the inner one.

6.3.2 *Degree of Super Elevation*

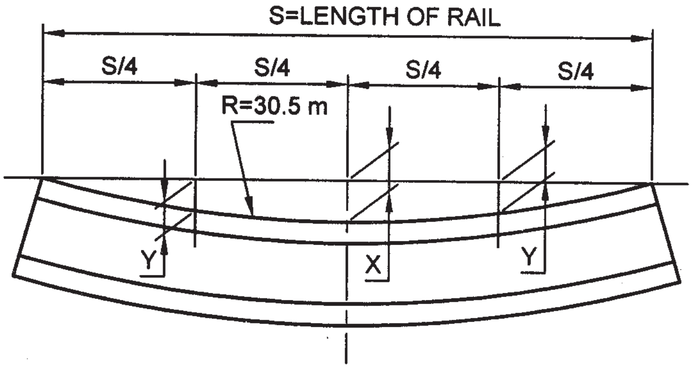
6.3.2.1 *For locomotive haulage*

The degree of super elevation required is dependent on the radius of the curve, the speed at which the train is travelling and the gauge of the track.

Table 2 Offsets for Bending Rails to Various Centre Line Radii (for Single Track 760 mm Gauge and 4 m Rails)

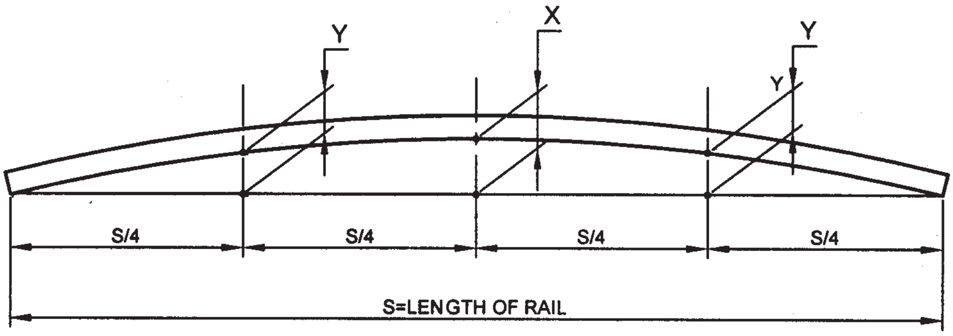
(*Clauses* 6.2.2 *and* 6.2.3)

Sl No.	**Centre Line Radius**	**Inner Rail**			**Outer Rail**		
		Radius to Running Edge of Rail	Offset *X*	Offset *Y*	Radius to Running Edge of Rail	Offset *X*	Offset *Y*
	M	m	mm	mm	m	mm	mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	12	11.62	173	130	12.38	162	121
ii)	15.25	14.87	135	101	15.63	128	96
iii)	20	19.62	102	76.5	20.38	98	73.5
iv)	24.4	24.02	83	62	24.78	81	61
v)	30.5	30.12	66	49.5	30.88	65	49
vi)	40	39.62	50.5	38	40.38	49.5	37
vii)	50	49.62	40	30	50.38	40	30
viii)	61	60.62	33	25	61.38	33	25



Sl No. (1)	Gradient m (2)	XL m (3)	S mm (4)	X mm (5)	Y (6)	Number Required per Track per Bend (7)
i)	1 in 3	4.987	4.902	98	74	4
ii)	1 in 4.5	6.665	6.653	182	137	2
iii)	1 in 6	5.004	4.998	104	77	2

FIG. 7 DETAILS OF BEND RAIL FOR DOUBLE TRACK



Let

S = length of rail, in m; and

R = radius of curvature, in m.

Then

$X = 1.5\ (S^2/R)$

and $Y = 0.75\ X$

FIG. 8 OFFSETS FOR BENDING RAILS TO CENTRE LINE RADII FOR DOUBLE TRACK

6.3.2.2 Where the calculated amount of super elevation for a particular speed and radius exceeds the specified maximum, the radius shall, if possible, be increased. Where this cannot be arranged, a speed limit shall be imposed on the curve.

6.3.2.3 If, for any reason, it is impracticable to super elevate the outer rail, a lower speed limit shall be imposed.

6.3.2.4 A check rail may be provided along the inside rail of the curve for its full length, if found to be necessary.

6.3.3 *For Rope Haulage*

In some forms of rope haulage, it may be necessary to raise the inner rail above the outer, to counteract rope pull. Each particular case shall however, be considered on its merit.

6.3.4 *Super Elevation*

The calculated amount of super elevation for various gauges, radii and speeds is given in Table 3 for information.

6.3.4.1 In practice it shall usually be found that 0.8 to

0.9 times of this amount shall be adequate and a tolerance downward equal to 0.25 times of the value given in Table 3 may be allowed.

6.3.4.2 Where, however, the full super elevation is under 50 mm, a tolerance of 12 mm (below the full value) shall apply.

6.3.5 *Notice for Super Elevation*

In both the cases, locomotive or rope haulage, a notice shall be posted on the side of the tunnel nearest the higher rail, at the out bye end of the curve, giving the super elevation with its tolerance for the information of plate layers.

7 HORIZONTAL TRANSITION CURVE

7.1 A horizontal transition curve is, a length of track which is inserted between the straight track and curved track to bring about a gradual change from the straight to the full radius of the curve, and at the same time a gradual change from the flat to the full appropriate super elevation.

7.2 Transition curves make a safer and more comfortable ride and make it easier to couple up vehicles when this is necessary at such places. A sudden increase in throw over, caused by a sudden severe decrease in curve radius, sets coupling appreciably out of line and makes docking difficult or in severe cases, impossible.

7.3 Carefully worked out transition curves shall make it possible to use smaller radius curves and still retain the ability to couple up, where it shall otherwise be impossible.

7.4 The use of a transition curves and offsets for transition curves is illustrated in Fig. 9. In order to insert a transition curve between a circular curve and the straight portion, it is necessary to offset the curve. This offset is termed the 'shift' and is measured at the centre of the transition curve.

7.4.1 Also the offset h from the straight produced to a point on the transition curve at a distance A from its commencement is given by:

Offset $h = A^3/(6\,DR)$

The radius 'r' at this point is given by:

$$r = DR/A$$

7.5 Determination of Length

When setting out a permanent curve with a gradual transition, its length may be determined on the basis of 1 mm increase in super elevation in 300 to 400 mm of length.

Table 3 Super Elevation for Various Gauges, Radii and Speeds
(*Clauses* 6.3.4 *and* 6.3.4.1)

Sl No.	**Speed** m/s	**Radii of Curves,** m			
		30.5	45.7	61	100
(1)	(2)	(3)	(4)	(5)	(6)
i)	*Gauge 604 mm — Maximum Super Elevation 76 mm*				
	3.35	23	15	11	7
	4.47	38	27	20	12
	6.25	Do not use	53	40	24
	8.04	Not recommended for mining condition on 604 mm gauge track			
	11.17	Not recommended for mining condition on 604 mm gauge track			
ii)	*Gauge 760 mm — Maximum Super Elevation 95 mm*				
	3.35	29	19	14	9
	4.47	51	34	25	15
	6.25	Do not use	64	50	30
	8.04	Do not use	Do not use	82	50
	11.17	Do not use	Do not use	Do not use	95
iii)	*Gauge 916 mm — Maximum Super Elevation 114 mm*				
	3.35	34	23	17	10
	4.47	61	41	30	19
	6.25	Do not use	80	60	36
	8.04	Do not use	Do not use	99	60
	11.17	Do not use	Do not use	Do not use	114
iv)	*Gauge 916 mm — Maximum Super Elevation 133 mm*				
	3.35	40	27	20	12
	4.47	71	47	36	22
	6.25	Do not use	Do not use	69	40
	8.04	Do not use	Do not use	114	70
	11.17	Do not use	Do not use	Do not use	113

NOTE — For radii of less than 30.5 m, a speed limit of 2.24 m/s shall be imposed as at this speed super elevation is not required.

7.6 Shift *S* and the offset *h* may be determined as in 7.5 from the length *A*.

7.7 Persons responsible may work out the details and provide a ready reckoning table of offset and distance required for bending the track. The line of the transition shall also be marked on roof on the roadway.

7.8 In case where super elevation is provided, but a transition curve cannot be included, the super elevation shall be built up gradually to its full value on the straight track on either side of the curve.

8 WIDENING OF GAUGE ON CURVES

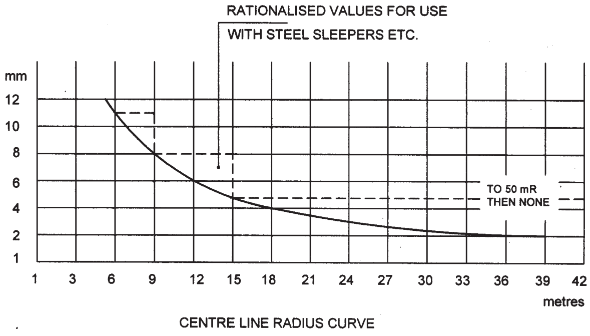
8.1 It is advisable to widen the gauge on curves so as to prevent the wheel flanges binding on the rails.

8.2 Degree of Widening

The degree of widening varies from zero on straight track to 10 mm at 8 m radius.

8.3 Where the rail track gauge is widened on a curve fitted with a check rail, the flange way shall be increased by an equal amount to prevent the flanges of the inner wheels binding between check rail and running rail.

8.4 Gauge widening on curves produced automatically is illustrated by the graph given below:



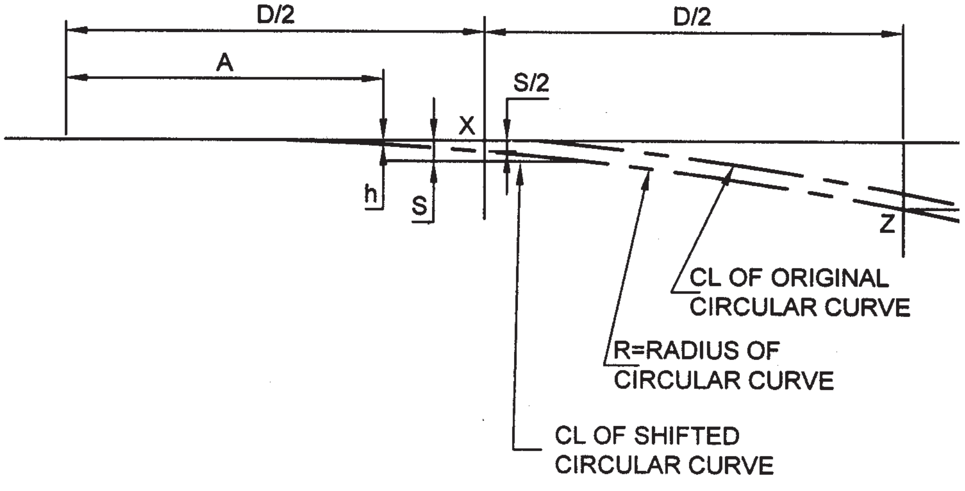
9 REVERSE CURVES

9.1 At points where a length of curve passes into another length of curve of the opposite lead, it shall be necessary to allow room between two curves for a length of straight track. The ideal is to allow enough room for a transition from the curve to the straight, a straight portion at least equal to the length of one wheel base and a transition back to next curve.

Offset $h = A^3/(6\ D\ R)$

The radius 'r' at this point is given by:

$r = D\ R\ /\ A$



Let

D = length of transition curve, in m;
S = shift, in m; and
R = radius of circular curve, in m.

Then

$S = D^2/(24R)$

FIG. 9 DETAILS OF SHIFT AND OFFSET FOR TRANSITION CURVE

9.1.1 The straight portion shall be level across its width and the two transitions shall lead into the correct super elevation of the curve.

9.1.2 Without the straight portion, the pair of couplings which spans the reversal shall be connecting two vehicles having large end throws to opposite sides. The resulting excessive angularity of the couplings may cause derailment and shall almost certainly lead to heavy wear or damage to the vehicle. The values for overhang and throws of vehicles on curve may be obtained as given in Fig. 10.

10 ANCHORAGE OF TRACK TO THE FLOOR

10.1 Where the gradient is 1 in 3 or more, the track shall be secured either to the floor or to the sides of the gallery.

10.2 Anchor ties shall be fastened with the help of a longer fish bolt at one end and grouting at the other end.

11 SWITCHES AND CROSSINGS — GENERAL REQUIREMENTS TERMINOLOGY

11.1 Flangeway — It is the gap between following three pairs of rails through which wheel flange passes:

a) Tongue and stock rails of a switch in open position;

b) Running rails and check rails in crossing portion; and

c) Wing rails and vee rails in crossing portion.

In underground mine haulage tracks, it amounts to 35 mm plus gauge widening, if any.

11.2 Heel of a Switch — The point at which standard flangeway is obtained.

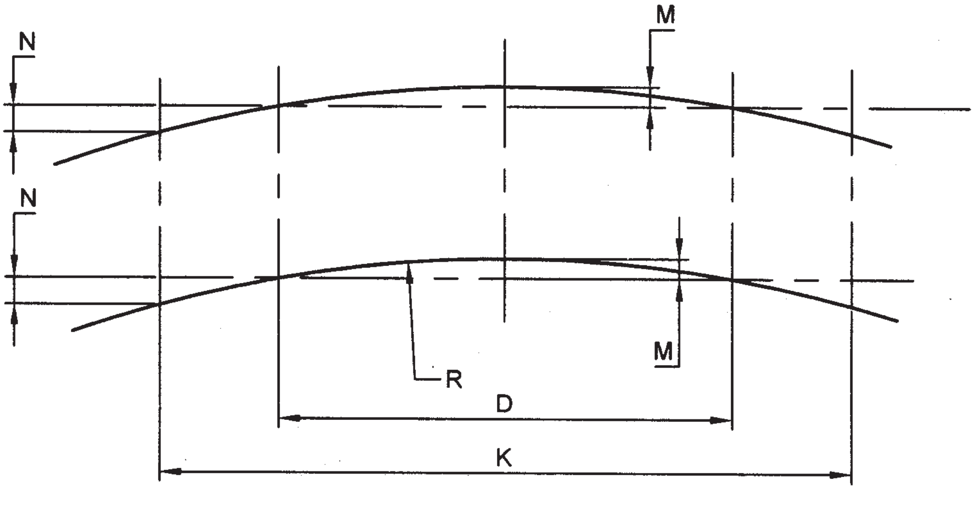
11.3 Switch Heel Divergence — It is the distance between gauge lines of stock rails and tounge rails at the heel. It is equal to the clearance between these two rails at heel plus the width of tounge rail head.

11.4 Plan Length of a Switch — This is equal to:

$$\frac{\text{Rail head width} \times \text{Switch length}}{\text{Switch heel divergence}}$$

11.5 Switch Angle — The angle having a tangent equal to:

$$\frac{\text{Switch heel divergence}}{\text{Switch angle}}$$



Let

N = end throw;

K = length of vehicle;

M = centre throw or overhang;

R = radius of centre line of curve; and

D = wheel base (for a fixed axle vehicle or distance between bogie centres).

Then

$M = D^2/(8R)$

$N = (K^2 - D^2)/(8R)$

FIG. 10 METHOD FOR CALCULATION OF OVERHANG AND END THROW

11.6 Switch Throw — The distance moved by the point or toe of the switch from one extreme position to the other.

11.7 Crossing Angle — The angle between the running edges of the two rails making up the 'Vee' of the crossing.

11.7.1 On a plan of the tracks the angle between the tangents to the two tracks at their point of intersection is equal to the crossing angle.

11.7.2 From Fig. 11A, it shall be clear that the unit angle is the ratio of *A* to *B* , where *A* is the length of bisector between this line and the intersections of the legs; and *B* is the distance between the legs of the angle at any point measured along a line at right angles to the bisector.

Thus, unit angle = *A/B*, angle is 1 in *A/B*

11.8 Crossing Nose — The point of intersection of the gauge lines of the two rails making up the crossing 'Vee', forms the theoretical nose of crossing.

11.8.1 The actual nose of the crossing shall not run to a fine point but usually remains 10 mm thick but not less than the web thickness of rail. Thus, the actual nose is this thickness multiplied by crossing angle behind theoretical nose of the crossing as shown in Fig. 11B.

11.9 Lead — The distance from the toe or point of a switch to a point opposite the crossing nose measured along a straight line tangential to the main track at the switch heel.

11.10 Facing Turnout, is that in which the train passes first over a switch and then over the crossing.

11.11 Trailing Turnout — It is reverse of facing turnout. In this, the train passes first over a crossing and then over the switch.

12 NOMENCLATURE

The nomenclature of the various parts of a turnout shall be as given in Fig.12.

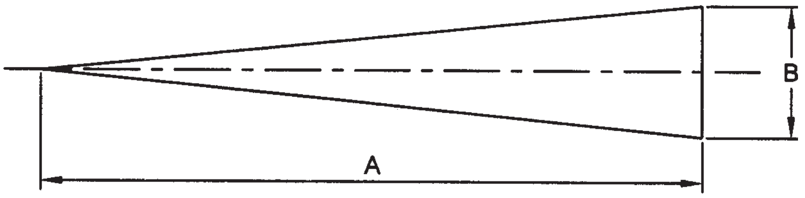
13 DIMENSIONS AND CONSTRUCTIONAL DETAILS

13.1 Recommended dimensions of turnouts off straight track for ISLR 15 and ISLR 25/ 30 of gauge 610 mm are given in Tables 4 and 5 respectively.

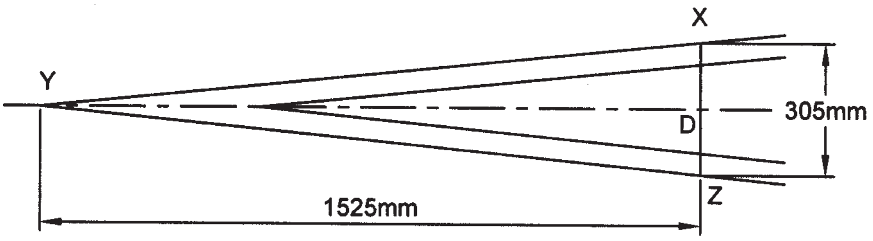
13.2 Constructional Details

13.2.1 *Switch Blade*

The length of switch blade shall be greater than the longest wheel base which shall pass over it under normal operating conditions, otherwise there shall be a tendency for the point to kick open (away from the stock rail) as the vehicle passes, possibly causing a derailment.



11A Methods of Measurement of Crossing Angle Measurement on the Unit System



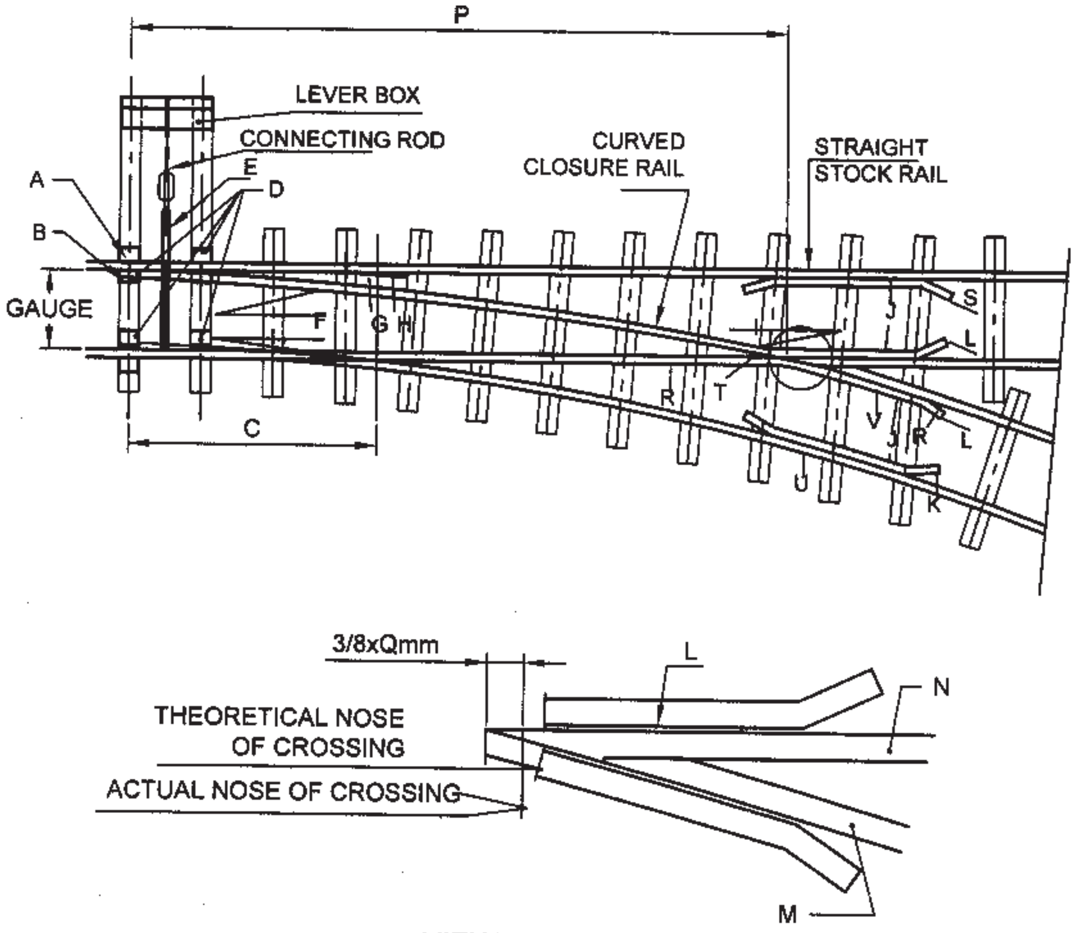
11B Example for Unit Angle

For example

A = *YD* = 1 525 mm; and

B = ZX = 305 mm; therefore angle is 1 in 1 525/305, or 1 in 5.

FIG. 11 UNIT ANGLE



VIEW-X

A = toe of switch
B = switch throw
C = length of switch
D = slide plate
E = stretcher rod
F = switch blades
G = heel of switch
H = heel block
I = knuckle of crossing
J = flangeway

K = check block
L = wing rail
M = spice rail
N = point rail
P = load of turnout
Q = angle of crossing (1 in *Q*)
R = sraight closure Rail
S = check rail
T = knuckle block
U = curved stock
V = nose block

FIG. 12 NOMENCLATURE OF VARIOUS PARTS OF TURNOUT

13.2.2 *Crossing Vee or Frog*

It is generally recommended that crossing vee or frogs shall be built up from rails.

13.2.3 *Closure Rails*

In a turnout off straight track there shall be two closure rails, one straight and one curved as shown in Fig.12.

13.2.4 *Lever Boxes*

There shall be mainly three types of lever boxes used with mine track,

a) Weight assisted type;
b) Flush fitting floor type (generally used where space is limited); and
c) Spring lever box type. In this type an over center spring presses the switch blade which is currently in use against the appropriate stock rail.

13.2.4.1 *Operational note*

The movement of the switch blade is liable to be impeded by small stones, so the personnel who operate

Table 4 Dimensions of Turnouts off Straight Track for ISLR 15 Rails and Gauge 610 mm

(*Clause* 13.1)

Sl No.	Crossing Angle	Length of Straight in Front of Theoretical Nose	Distance Apart of Gauge Lines at Distance in Front of Nose	Switch Details			Lead	Curved Closure Rail		Length of Straight Closure Rail
	Y Degree	*S* mm	*t* mm	Length *d* m	Angle *X* Degree	Heel Spread *L* mm	*DA* m	Radius *R* m	Offset *W* mm	m
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	2.00	152	76	0.914	10	80.9	1.538	3.776	76	1.143
ii)	2.25	171	76	0.914	10	80.9	1.692	4.832	72	1.308
iii)	2.50	191	76	0.914	10	80.9	1.840	6.041	68	1.473
iv)	2.75	210	76	0.914	10	80.9	1.983	7.414	64	1.587
v)	3.00	229	76	1.829	20	80.9	2.392	8.344	84	1.969
vi)	3.25	248	76	1.829	20	80.9	2.562	9.831	82	2.127
vii)	3.50	267	76	1.829	20	80.9	2.728	11.452	80	2.286
viii)	3.75	286	76	1.829	20	80.9	2.891	13.208	78	2.444
ix)	4.00	305	76	1.829	20	80.9	3.050	15.103	76	2.604
x)	4.25	324	76	1.829	20	80.9	3.206	17.142	74	2.763
xi)	4.50	343	76	1.829	20	80.9	3.359	19.329	72	2.909
xii)	4.75	362	76	1.829	20	80.9	3.508	21.668	70	3.055
xiii)	5.00	381	76	1.829	20	80.9	3.655	24.165	68	3.201
xiv)	5.50	419	76	1.829	20	80.9	3.940	29.655	64	3.442
xv)	6.00	457	76	1.829	20	80.9	4.214	35.850	61	3.683
xvi)	6.00	457	76	2.743	30	80.9	4.562	33.983	76	4.013
xvii)	6.50	495	76	1.829	20	80.9	4.477	42.809	58	3.987
xviii)	6.50	495	76	2.743	30	80.9	4.873	40.173	73	4.369
xix)	7.00	533	76	1.829	20	80.9	4.731	50.603	55	4.267
xx)	7.00	534	76	2.743	30	80.9	5.175	46.961	70	4.698
xxi)	7.50	572	76	2.743	30	80.9	5.470	54.372	68	5.042
xxii)	8.00	610	76	2.743	30	80.9	5.756	62.437	66	5.360
xxiii)	8.50	648	76	2.743	30	80.9	6.036	71.188	63	5.511
xxiv)	9.00	686	76	2.743	30	80.9	6.308	80.662	61	5.829
xxv)	9.00	686	76	3.658	40	80.9	6.692	77.316	72	6.210
xxvi)	9.50	724	76	3.658	40	80.9	6.991	86.673	70	6.375
xxvii)	10.00	762	76	3.658	40	80.9	7.285	96.661	68	6.731

turn-outs shall always be instructed to check that the required blades have gone home snugly against the appropriate stock rail.

13.2.4.2 It is desirable that on more important turnout, particularly facing turnouts on tracks used for main coal/material haulage or man riding, detection of full level of blades by means of FLP limit switches and indication lights be provided.

13.2.4.3 It shall be noted that an incorrectly set trailing turnout, seldom causes derailment, but facing turnouts set for the wrong road or stuck half way, shall frequently be the cause of accidents.

13.2.4.4 *Connecting rods*

Connecting rods shall be made between the lever box and the switch blades complete with a turn buckle for adjustment, as shown in Fig. 13. This shall restrict movement of lever boxes on timbers to obtain adjustment of the switch movement.

13.2.5 *Stretcher Rods*

Stretcher rods shall be used to connect the two switch blades of a turnout and maintain these blades in their correct position, relative to one another.

13.2.5.1 The stretch rod shall be a simple flat bar fastened to the base of the rail. Figure 14 indicates two types of stretcher rods.

14 TYPES OF LAYOUT

14.1 Cross Over Roads from a Straight to a Parallel Straight Track

The cross-over consists of two turnouts connected together by a length of straight track as shown in Fig. 15. Formula for calculation of length of straight is given in Fig. 15.

14.2 An illustration of simple turnout off a straight main track is given in Fig.16. Formula for calculation of this turnout off a straight main line is given in Fig. 16.

14.3 Turnouts off Curved Main Lines

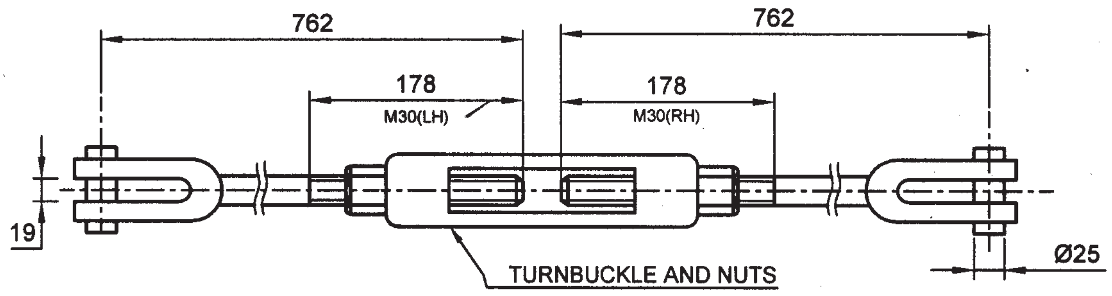
In some cases it shall be necessary to have turnouts off curved main lines. In these instances it may be assumed (although it may not be mathematically correct) that the lead of a turnout off a curve shall be the same as that of a turnout off the straight, provided that the same

Table 5 Dimensions of Turnouts off Straight Track for ISLR 25[1] and ISLR 30 Rails of Gauge 610 mm

(*Clause* 13.1)

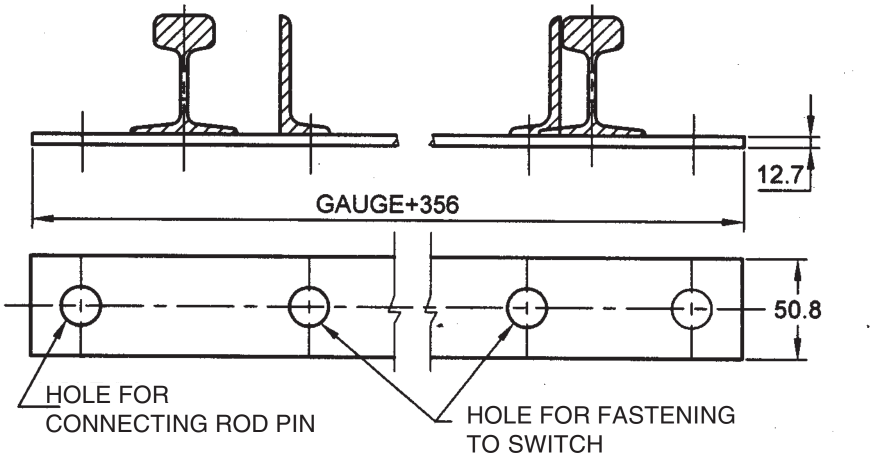
Sl No.	Crossing Angle	Length of Straight in Front of Theoretical Nose	Distant Apart of Gauge Lines at Distance in Front of Nose	Switch Details			Lead	Cuved Closure Rail		Length of Straight Closure Rail
				Length	Angle	Heel Spread		Radius	Offset	
	Y	*S*	*t*	*d*	*X*	*L*	*DA*	*R*	*W*	
	Degree	mm	mm	m	Degree	mm	m	m	mm	m
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	2.00	152	76	0.914	10	92	2.565	3.658	75	1.143
ii)	2.25	171	76	0.914	10	92	2.731	4.724	70	1.308
iii)	2.50	191	76	0.914	10	92	2.896	5.943	65	1.473
iv)	2.75	210	76	0.914	10	92	3.061	7.239	63	1.587
v)	3.00	229	76	1.829	20	92	4.394	8.154	83	1.969
vi)	3.25	248	76	1.829	20	92	4.585	9.601	79	2.127
vii)	3.50	267	76	1.829	20	92	4.763	11.125	78	2.286
viii)	3.75	286	76	1.829	20	92	4.941	12.802	76	2.444
ix)	4.00	305	76	1.829	20	92	5.118	14.782	73	2.604
x)	4.25	324	76	1.829	20	92	5.296	16.764	72	2.763
xi)	4.50	343	76	1.829	20	92	5.461	18.898	70	2.909
xii)	4.75	362	76	1.829	20	92	5.626	21.156	68	3.055
xiii)	5.00	381	76	1.829	20	92	5.791	23.622	67	3.201
xiv)	5.50	419	76	1.829	20	92	6.109	28.956	64	3.442
xv)	6.00	457	76	1.829	20	92	6.426	35.052	60	3.683
xvi)	6.00	457	76	2.743	30	92	7.671	33.223	75	4.013
xvii)	6.50	496	76	1.829	20	92	6.731	41.758	57	3.987
xviii)	6.50	496	76	2.743	30	92	8.027	39.319	70	4.369
xix)	7.00	534	76	1.829	20	92	7.010	49.378	52	4.267
xx)	7.00	534	76	2.743	30	92	8.356	45.720	70	4.698
xxi)	7.50	572	76	2.743	30	92	8.699	53.036	67	5.042
xxii)	8.00	610	76	2.743	30	92	9.017	60.960	64	5.360
xxiii)	8.50	648	76	2.743	30	92	9.322	69.494	62	5.511
xxiv)	9.00	686	76	2.743	30	92	9.640	78.639	60	5.829
xxv)	9.00	686	76	3.658	40	92	10.935	75.590	70	6.210
xxvi)	9.50	724	76	3.658	40	92	11.252	84.735	68	6.375
xxvii)	10.0	762	76	3.658	40	92	11.607	94.183	60	6.731

[1] For details of ISLR 25, *see* IS 3964.

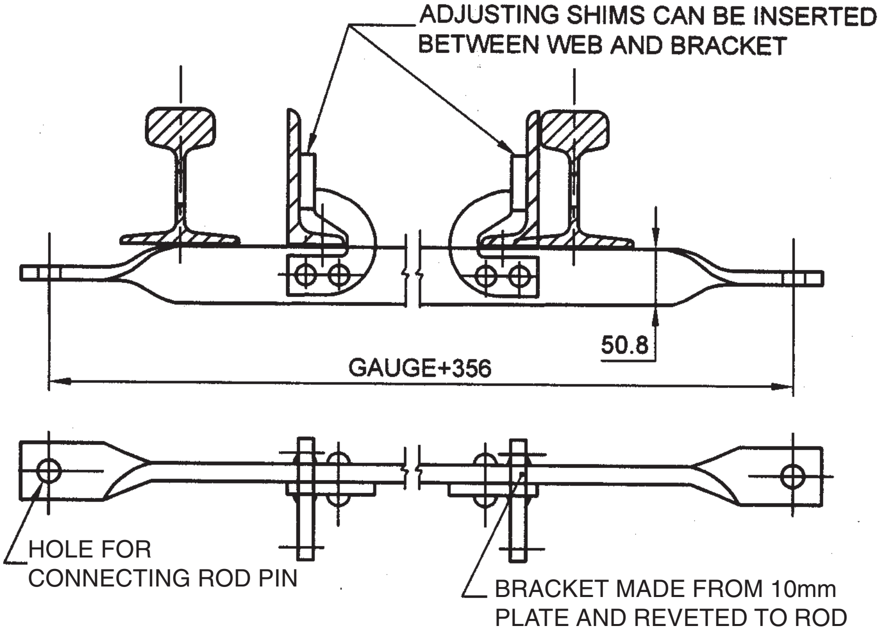


All dimensions in millimetres.

FIG. 13 SWITCH CONNECTING ROD INCORPORATING A TURNBUCKLE

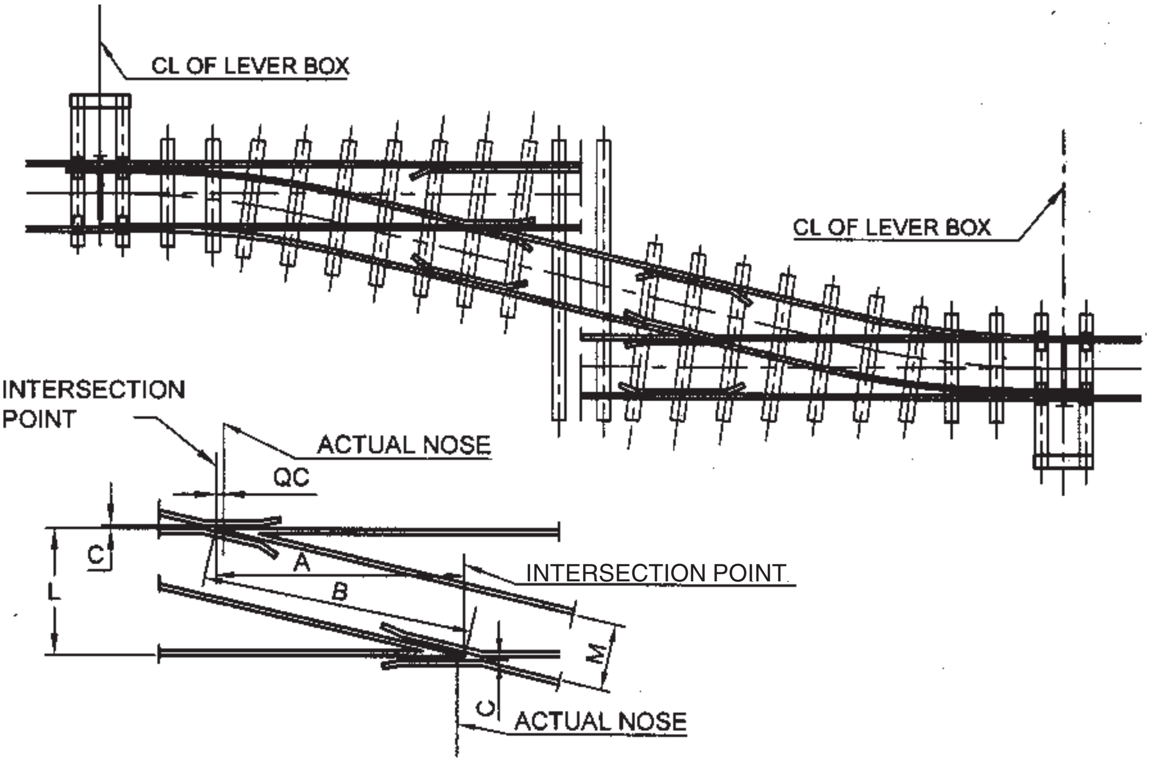


SIMPLE FLAT- BAR STRETCHER ROD



All dimensions in millimetres.

FIG. 14 STRETCHER ROD WITH BRACKETS



Let

A = lead between theoretical noses of the two crossings measured parallel to the main lines,

A_x = lead between actual noses of the two crossings measured parallel to the main lines,

B = distance between the theoretical crossing noses measured along the centre of the diagonal track,

Q = unit angle of the two crossings,

L = space between the gauge lines of the two parallel tracks,

M = gauge, and

P_x = lead from toe to switch to actual nose of crossing (*see* Table 4).

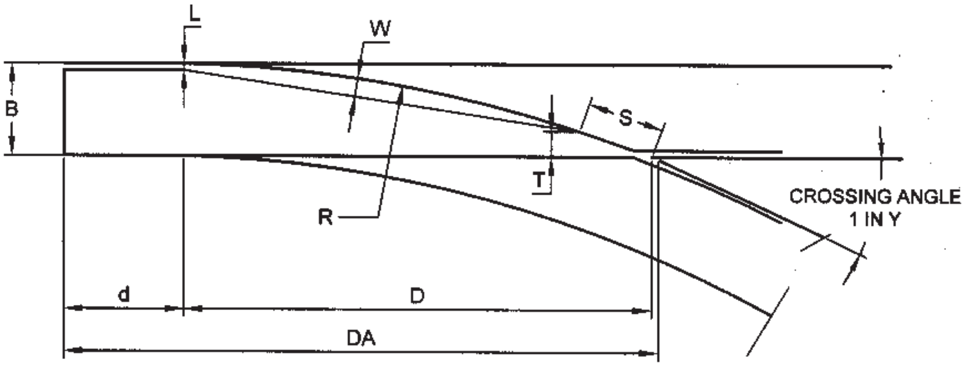
$A = Q (L - M)\text{-}(L + M)/ 4Q$

$A_x = A\text{–}2Q$

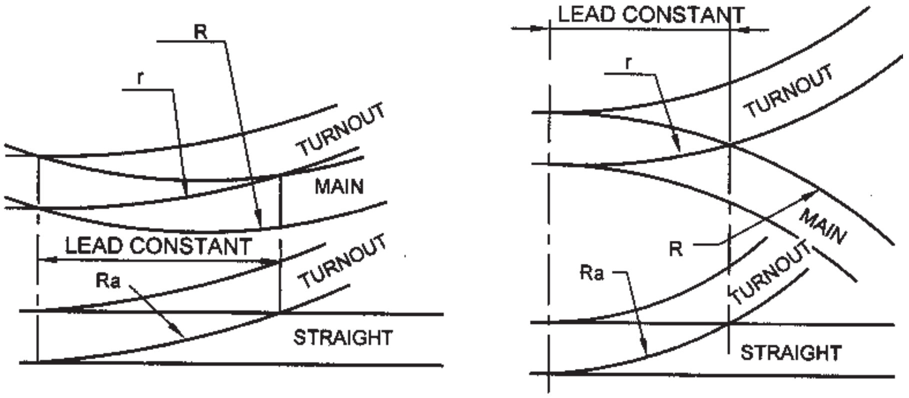
$B = Q (L\text{–}M) + (L\text{+}M)/ 4Q$

The overall length from switch toe to switch toe measured parallel to the main lines = 2 P_x+ A_x

FIG. 15 TYPICAL CROSSOVER WITH DIAGRAM SHOWING SYMBOLS USED IN CALCULATIONS



16A Key Diagram of Turnout off a Straight Track Showing Symbol Used in Table and Calculations



16B Illustrating the Conversion to an Equivalent Radius

Let

B = gauge,
L = switch heel divergence,
D = lead from heel of switch to theoretical nose of crossing,
DA = lead from toe of switch to actual nose of crossing,
d = switch length,
s = straight length in front of theoretical crossing nose,
t = distance between gauge lines at distance 'S' from theoretical nose of crossing,
v = thickness of crossing nose,
R = radius of curved closure rails,
W = offset from the curved closure rail to the midpoint of the chord joining the switch heel to a point at distance 'S' in front of crossing nose,
X = unit angle of switch, and
Y = unit angle of crossing.

With the exception of X and Y which are numbers, all the above items shall be taken in the same units.

Then

$$D = \frac{2XY(B-L-t)}{X+Y} + Yt$$

$$DA = D + d + Y\,v$$

$$R = \frac{2X^2Y^2(B-L-t)}{X^2Y^2}$$

$$W = \frac{2X-Y}{X+Y}\quad\frac{(B-L-t)}{4}$$

FIG. 16 TURNOUTS

type of switches and the same crossing angles are used. The radius of turnout curve shall be different in each of the two cases.

With the exception of X and Y which are numbers, all the above items shall be taken in the same units.

Then

$$D = \frac{2X(B - L - t)}{X + Y} + Yt$$

Figure 16B illustrating the conversion to an equivalent radius turnout off a curved track of similar flexure (left), and a turnout off a curve of contra-flexure (right).

15 DESIGN OF TURNOUTS

If the radii of the main track and the turnout curve are known, it is possible to calculate the equivalent radius of the turnout, if the main track was straight.

15.1 From the lead, crossing angle and type of switch may be obtained and hence, a complete turnout may be designed.

15.2 Illustration for the conversion to equivalent radius turnout off straight track of a turnout off curved track of similar flexure(left) and a turnout off a curve of contra-flexure (right) is given in Fig. 16A and the formula for calculation is given below:

Let

R = radius of the curved main line,

R = radius of the turnout curve, and

R_q = equivalent radius of the turnout in a straight main line.

Turnout and main line curves of similar flexure with $r < R$

$$R_q = (Rr)/(R - r)$$

Turnout and main line curves of similar flexure with $R < r$

$$R_q = (Rr)/(r - R)$$

Turnout and main line curves of opposite flexure

$$R_q = (Rr)/(R+r)$$

16 TIMBERING OF CROSSING WORK

16.1 Placement of Timbers (Sleepers)

Timbers (sleepers) shall be put directly under the crossing nose and one close on each side of it as shown in Fig. 17.

16.2 Size of Timber

16.2.1 *Cross-section*

Sleepers or timbers used for the support of crossing work shall be of the same cross section as the sleepers used on plain track.

16.2.2 *Length*

Length of the timber shall be equal to the distance between the outside gauge lines of the four rails plus 600 mm.

16.2.3 Lever box shall be carried on two long timbers. The length and center distance of these timbers shall be suitable for the type of lever box to be used.

16.3 The intermediate timbers between the switch heel and the crossing shall be set out at equal intervals but not exceeding 800 mm.

17 SPRING CONTROL SWITCHES

17.1 The switch blades shall normally be held for traffic in one direction, but any vehicle approaching from the side track may move the blades over against the spring and so pass on to the main tracks.

17.1.1 Spring controlled switches are commonly used for a drop back and an illustration of such a switch is given in Fig. 18.

17.2 On sleeper inclines where all traffic normally moves upward it is advisable to use a spring control switch as a catch point to derail and turn into the road side, any runaway vehicles coming back down the incline.

18 LAYING CODE OF PRACTICE FOR MINE HAULAGE TRACKS

For the purpose of laying of mining haulage tracks, the following definitions shall apply:

a) *Boxing-in* — It means putting in the ballast in the spaces between the sleepers.

b) *Fettling* — It is the work done to ensure that the track is on the line and that all waves are removed.

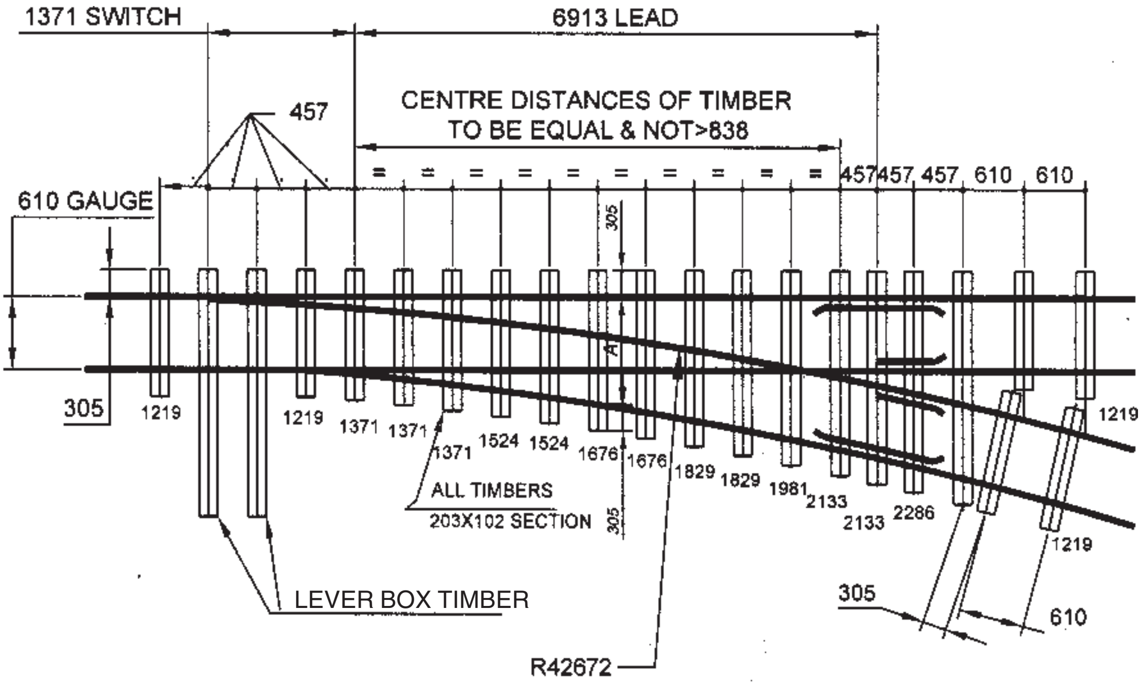
c) *Formation* — The part of the rock floor of the roadway on which track is laid.

d) *Opening out* — It means removing the ballast to the bottom of the sleeper and in the spaces between the sleeper.

e) *Packing* — It means inserting ballast under sleeper to ensure proper distribution of weight.

19 MATERIALS

19.1 Various materials and components/parts used in laying the mine haulage tracks shall conform to pre-determined and pre-selected standards and norms. Special attention shall be given while selecting and using rails, fish plates and fish bolts, sleepers and rail fastenings, gauge ties, ballast etc.



All dimensions in millimetres.

FIG. 17 STANDARD ARRANGEMENT OF TIMBERS FOR 610 mm GAUGE 1 IN 5 TURNOUT OFF STRAIGHT TRACK

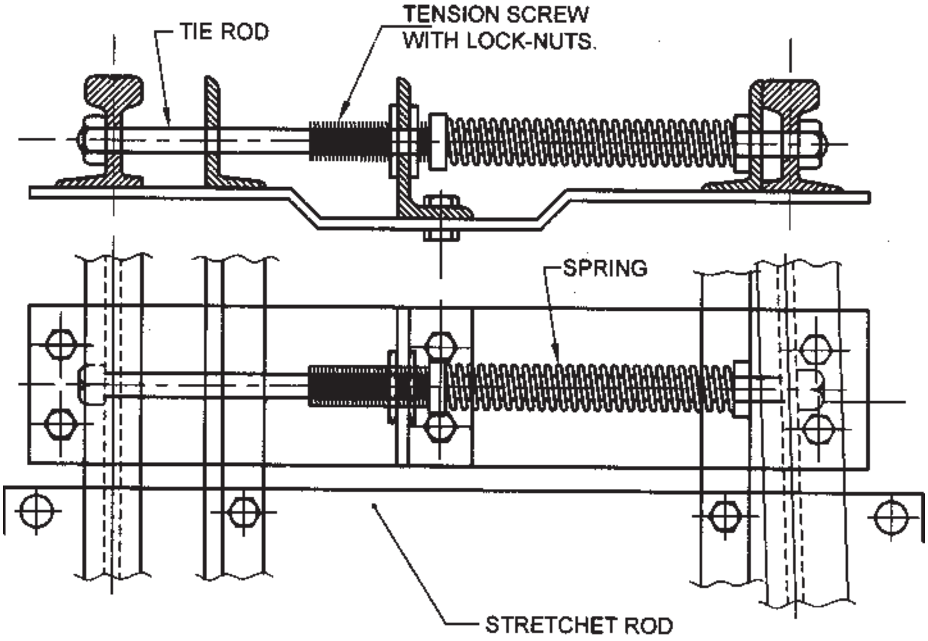


FIG. 18 SPRING-CONTROLLED SWITCH

19.2 While selecting and using the materials, components/parts due consideration shall be given to economical but efficient use of tracks keeping the 'safety' aspect above all.

19.3 Since the quality of ballast has a very important bearing on the standard of the finished track, the most suitable available material shall be used all the times. Few suggested materials are:

a) Crushed granite,
b) Crushed lime stone,
c) Crushed blast furnace slag,
d) Crushed hard stone,
e) Selected mine rocks, and
f) Fused boiler clinkers.

19.4 The essential characteristics of ballast shall be as given below:

a) It shall not crumble or disintegrate easily under working conditions either due to load or due to wet surroundings.
b) It shall have a high frictional characteristic so that the mass shall bind well together when laid down and yet remain porous to allow drainage and to maintain an elastic road bed.
c) The coarser material shall be used for the initial layer of ballast and the finer for the final packing and lifting to grade.
d) Crushed slag and clinker are unsuitable for damp conditions as they lead to increased corrosion of the rails.
e) Since some mine rocks disintegrate in wet conditions, care shall be taken while using these particular rock ballast.
f) Ballast of inert material shall be preferred in case of gassy mines where use of carbonaceous material such as coaly shale, coal, etc, is to be avoided.

20 MARKING AND SIZE OF ROADWAYS

20.1 Marking

Roadways shall be made such that the line of roads shall be regular both on straight as well as round curves. It shall be ensured that the roadway is of uniform gradient and its alignment shall more or less be straight except at curves. The track shall be laid with proper alignment and gradient.

20.2 Size

The sizes of the roadways shall be such that, including the clearance, they confirm to the statutory Acts, Rules and Regulations.

21 BALLASTING

21.1 Ballasting of tracks is important from performance point of view. Ballast shall be such that it fulfills its basic functions such as to transfer the applied load over a large supporting surface, holding the slippers in a horizontal plane but allow them to be readily adjusted in a vertical plane to maintain correct gradient and provide an elastic road-bed.

21.2 Laying of Ballast

21.2.1 To prepare the formation, the floor of the roadway shall be roughly graded out at a depth of at least 100 mm to 300 mm from the bottom of the rail depending on the competence of the rock formation on which the track is being laid subject to the condition that such thickness shall not be less than the thickness of the sleeper.

21.2.2 A thick bed of ballast varying between 75 mm and 150 mm depending upon condition and load shall be provided between the sleeper and the formation.

21.2.3 Where considerable floor lift is anticipated, this depth of formation shall be increased to allow for extra ballast, which can then be removed to maintain the correct rail level and grade as the floor rises.

21.2.4 Ballast shall be spread before the sleepers are laid. Size of ballast shall not be larger than 50 mm nor finer than 15 mm.

21.2.5 It is important that the slippers shall have a firm support and ballast shall be tamped under them and particularly under the ends and under the rails, while it shall be loose under the middle of the track.

22 MARKING FOR TRACK LINES

22.1 Lines of proposed tracks shall be marked clearly on the roof of the roadways. These shall be known as 'Track lines'.

22.2 The track line shall be marked directly above the one rail of the track, so that by plumbing down this line, another rail can be set to gauge.

23 MARKING OF GRADE LINES

23.1 The grade lines for track shall be clearly marked on the side of the roadway at a pre-determined height above the final rail level.

23.2 By marking grade lines on both sides of the roadway, cross leveling of the track shall be easy. Also, the track layers may string across the roadway and measure down to the rail heads.

24 CHANNELS

24.1 In wet conditions, a channel shall be marked and cut at one side to facilitate flow of water.

24.2 Depth of the channel shall be such that the normal water level in the channel shall remain below the bottom of the ballast.

24.3 Edge

Edge of the channel shall be at least 600 mm from the gauge line of the track to allow correct ballasting. Also, ends of the sleepers shall not block the channel.

24.4 In some cases it may also be required to line the channel with wood or concrete slabs to stop rush of water washing away the channel sides and ultimately destroying the drainage system.

24.5 If it is required that the channel has to cross the track, then in that case, the channel shall be completely covered over and protected from blockage at each end, since such a blockage may rapidly lead to flooding of the roadbed.

25 INSPECTION AND MAINTENANCE

25.1 Once the track has been laid and boxed-in it shall be essential to follow a systematic schedule of inspection and maintenance, to keep the track in a safe condition and for the efficient working of the haulage system. The schedule of inspection and maintenance shall include daily, weekly and annual checks to be made and corrective actions to be taken.

25.1.1 *Daily Inspection and Maintenance*

25.1.1.1 Haulage track, used by locomotives, shall be examined at least once in 24 h. It is recommended that all heavy haulage tracks shall be examined in the same way.

25.1.1.2 The person in-charge of each gang for inspection and maintenance of track layer shall daily examine and report on all the track layer under his charge. The arrangement may include that he walks one way and rides the other portion. He shall ensure that all points, crossings and movable parts are thoroughly examined and lubricated. Any defect found during the inspection shall receive his immediate attention and shall be rectified.

25.1.2 *Weekly Inspection and Maintenance*

It shall include the following:

a) All fasteners and fish bolts shall be tested with hammer and a spanner and tightened, if found loose. Also, the rails and sleepers shall be checked for cracks, fractures etc and replaced if needed;
b) All curves shall be inspected to check super elevation and alignment;
c) All turnouts and crossings shall receive particular attention; and
d) Inspection of alignments, levels and clearance along the length of the tracks shall be made.

25.1.2.1 The head lamp of locomotives, if available, shall be used to detect bad alignment and level. The person in-charge for inspection and maintenance shall stand about 15 to 20 m from the locomotive and then by looking towards the head lamp, he shall see the defects, if any, for corrective actions.

25.1.2.2 Horizontal and vertical rollers used for guiding ropes, skid plates etc shall be checked and replaced if found damaged. Rollers and pulleys conform to IS 9203 (Parts 1 to 4). The mountings shall conform to IS 9227.

25.1.3 *Annual Inspection and Maintenance*

25.1.3.1 All main haulage tracks and men riding tracks shall be examined at least once a year as specified in **25.1.3.2**

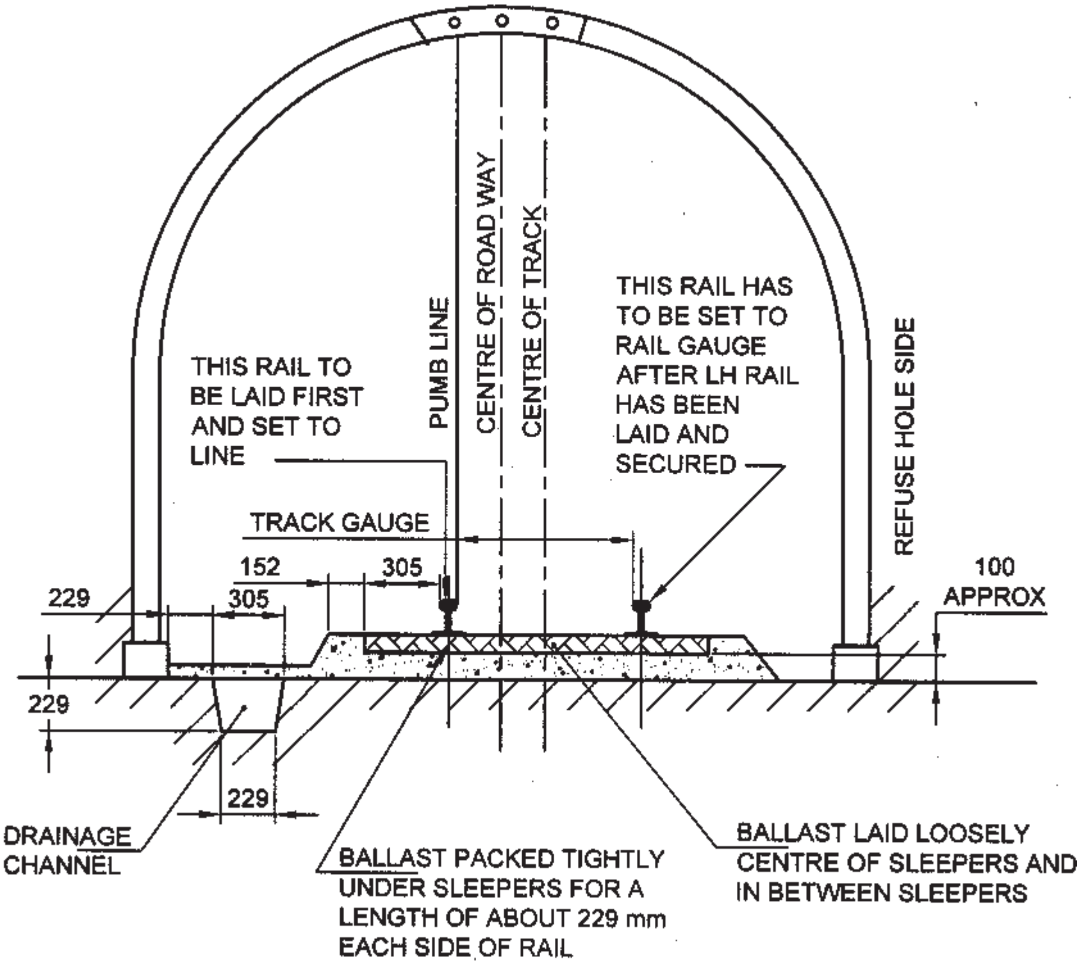
25.2 All fish plates shall be removed, the ends of the rails examined, cleaned, fish plates greased and bolts oiled; and worn out fish plates replaced. All fasteners and sleepers shall be re-examined for further use or discarding before these are re-used after annual inspection.

25.3 Any fasteners or sleepers or other components which do not appear to be in good condition, shall be examined under load that is, as the train passes over them, as these defects may not be revealed.

26 TYPICAL SECTIONS OF TRACKS

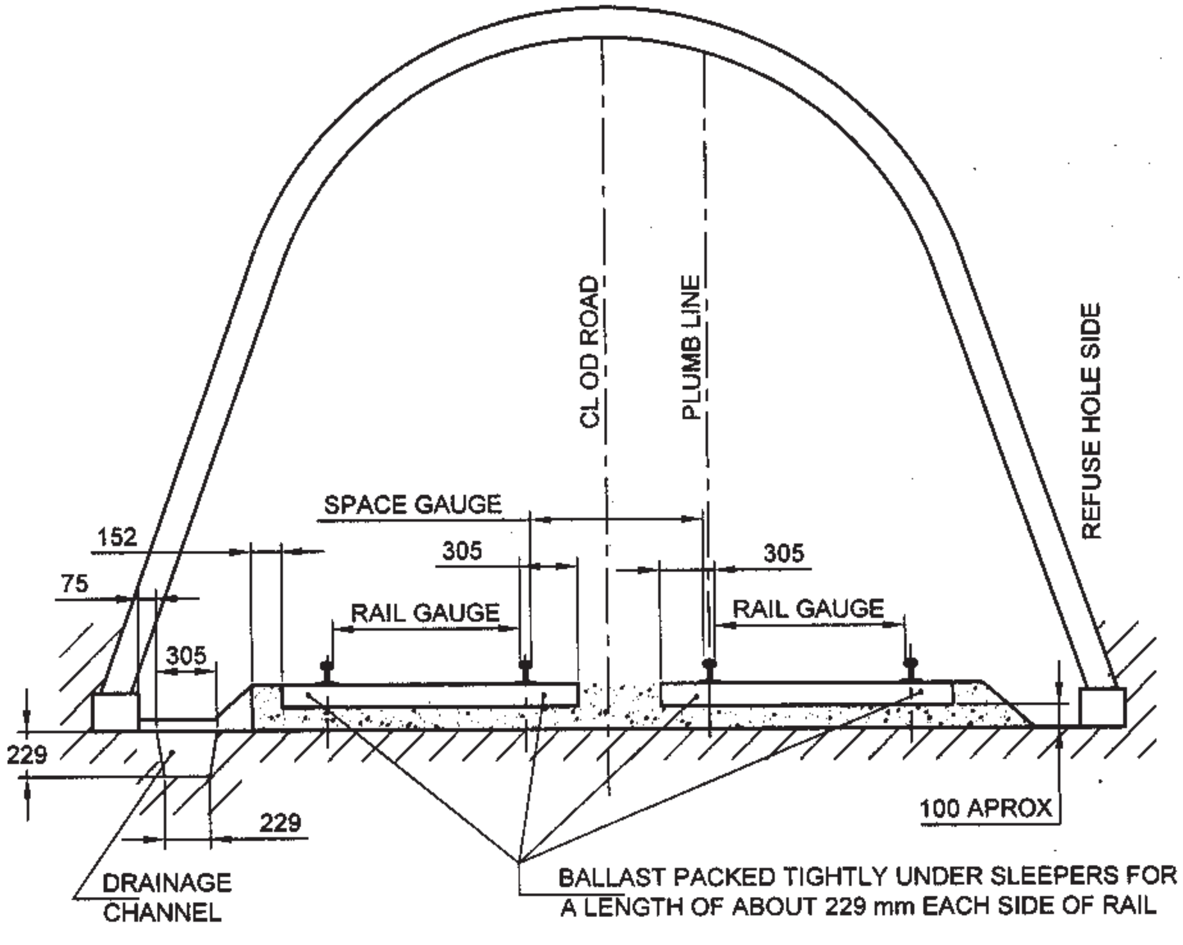
26.1 Typical section across straight single track roadway with drainage channel is given in Fig. 19.

26.2 Typical section across curved double track roadway with drainage channel is given in Fig. 20.


PUMB LINE
CENTRE OF ROAD WAY
CENTRE OF TRACK
THIS RAIL HAS TO BE SET TO RAIL GAUGE AFTER LH RAIL HAS BEEN LAID AND SECURED
THIS RAIL TO BE LAID FIRST AND SET TO LINE
REFUSE HOLE SIDE
TRACK GAUGE
152
305
229
305
100 APPROX
229
229
DRAINAGE CHANNEL
BALLAST PACKED TIGHTLY UNDER SLEEPERS FOR A LENGTH OF ABOUT 229 mm EACH SIDE OF RAIL
BALLAST LAID LOOSELY CENTRE OF SLEEPERS AND IN BETWEEN SLEEPERS

All dimensions in millimetres.

FIG. 19 TYPICAL SECTION ACROSS STRAIGHT SINGLE TRACK ROADWAY WITH DRAINAGE CHANNEL



All dimensions in millimetres.

FIG. 20 TYPICAL SECTION ACROSS CURVED DOUBLE TRACK ROADWAY WITH DRAINAGE CHANNEL

ANNEX A

(*Foreword*)

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